REMARKS

The above Amendments and these Remarks are submitted under 35 U.S.C. § 132 and 37 C.F.R. § 1.116 in response to the final Office Action mailed February 7, 2006.

Summary of the Examiner's Action

The Examiner rejects claims 1-16 under 35 U.S.C. § 103(a) as being unpatentable over Galloway (U.S. Patent No. 6,187,465) and Webster, Jr. *et al.* (U.S. Patent No. 6,086,722) and further in view of McIntosh *et al.* (U.S. Patent No. 5,662,052).

Summary of the Applicant's Response

In this response to the February 7, 2006 Office Action, the Applicant has amended claims 1 and 6 to more clearly define the Applicant's presently claimed method so that it is not obvious to one of ordinary skill in the art based on any combination of the cited prior art, to narrow any remaining issues in this case, and to lead to claims that are now in a condition for allowance.

Claim 1 now contains the phrase "indirectly heated" to further define the gas-phase kiln and the phrase "at a temperature gradient along the length of the kiln of about 200° to about 1600°C (400-2900°F)" to further define the operating conditions within the kiln. Claim 6 has been amended to indicate that it is preferred that the kiln be indirectly heated over its entire length.

Full support for these limitations is found throughout the specification, e.g., see pages 7, lines 15-16 and page 7, line 32 to page 8, line 4 of the subject specification that states that the kiln is heated indirectly. The phrase "at a temperature gradient along the length of the kiln of about 200° to about 1600°C (400-2900°F)" is found in the paragraph on page 4, lines 7-10.

To summarize, claims 1 and 6 have been amended and claims 1-16 remain pending.

Response to Rejection of Claims 1-16 under 35 U.S.C. § 103(a)

Claim 1 has now been amended to clearly overcome the rejection of claims 1-16 based on Galloway in view of Webster *et al.* and further in view of newly cited McIntos*h et al.*

As supported in Applicant's specification on page 8, lines 2-5, the carbonaceous feedstock is introduced at one end of the kiln where the temperature is at about 200°C and the feedstock is then

subjected to increasing temperatures as it moves along the entire length of the kiln during the non-catalytic reaction to produce a synthesis gas that at least a portion of which is sent to a first half-cell of a fuel cell.

The third sentence of the Abstract of McIntosh *et al.* states:

"During operation, the temperature of the wall of the inner rotary kiln at the inlet is not less than about 500°C to heat the particulate material to a temperature in the range of from about 200°C to about 900 °C in a pyrolyzing atmosphere to reduce the particulate material as it moves from the one end toward the other end."

This requirement of McIntosh *et al.* that the wall of the inner rotary kiln at the inlet is not less than about 500°C is a limitation found in all of the claims. At column 4, lines 39-46, is stated:

" It is important, that the temperature at the inlet end of the reactor 10 be maintained in the range of from about 500°C to about 1000°C while the particulate material as it is transported from the inlet end toward the other end of the reactor 10..."

This distinction between the Applicant's temperature of about 200°C at the inlet end of the kiln and the McIntosh *et al.* temperature of 500°C at the inlet end is that violent and unwanted reactions could result if the Applicant's feed to the inlet end of the kiln that could contain water were exposed to such high temperatures. The particulates in the organic material that is fed to the inlet of the McIntosh *et al.* method must experience such high temperatures to insure that they are immediately heated to about 200°C

The other limitation of using an indirectly heated kiln is another important distinction between the method of McIntosh *et al.* and that of the Applicant. The source of heat for the McIntosh *et al.* kiln is direct heating from the combustion of particulate material in the feed within the annular space between the inner cylindrical kiln and the outer kiln. The source of direct heat for the McIntosh *et al.* kiln is inside the kiln and allows oxygen and other combustion gases to be present during the pyrolysis reactions taking place in the kiln. The presence of oxygen during the Applicant's steam reforming to syngas would be very harmful as discussed in some detail below.

Although the Applicant believes that these distinctions alone will enable the Examiner to recognize that the presently claimed invention is inventively and patentability distinguishable over the cited references, the Applicant will discuss below numerous other distinguishing features of the presently claimed invention over the cited references.

The reason why the "about 200°C" temperature at the inlet end of the Applicant's kiln is a crucial distinction over the "about 500°C" temperature at the inlet end of the McIntosh *et al.* kiln is the very great differences of the reactions occurring in the kiln Applicant's kiln versus the McIntosh *et al.* kiln.

In the Applicant's kiln, a non-catalytic steam reforming reaction occurs to produce synthesis gas. In the McIntosh *et al.* kiln, combustion reactions are occurring in the presence of oxygen in the annular space to heat the pyrolysis reaction in the presence of a catalyst. The pyrolysis reaction occurs in the inner kiln to produce such chemicals as cyclohexane and chloromethane.

In the Applicant's kiln, the feedstock enters the inlet end of the kiln and synthesis gas exits from the outlet at the opposite end of the kiln. In the McIntosh *et al.* kiln, particulates enter one end of double rotary kiln 10 through feed chute or conduit 50 and combustion gases exit outlet 29 at the opposite end of kiln 10. However, the real products that result from the McIntosh *et al.* method, i.e., the pyrolysis reaction products, exit in line 51 within the feed conduit 50 at the same end as the inlet to kiln 10.

In the Applicant's kiln, the solids are removed between the inlet and the outlet. In the McIntosh *et al.* kiln, the solids are not removed between the inlet and outlet, but at the same end wall 32 in which the feed enters kiln 10.

The Examiner states that it would be obvious in view of McIntosh *et al.* to remove the solids between the inlet and outlets because McIntosh *et al.* removes the char through exit 36. The Applicant traverses this line of reasoning, since not only does FIG. 1 clearly show that the solids exit is not between the inlet and outlet, but McIntosh *et al.* has a compelling reason for this arrangement. The entire design of the double rotary kiln of McIntos*h et al.* with the solids leaving at the same end as the feed is that the feed entering the kiln is cool and must immediately be heated to about 200°C by being exposed to at least about 500°C temperature at the inlet end. This high temperature is produced from the heat that is generated by the burning char in the annular space. If this char was removed prior to the inlet end of the kiln, there is no way the 500°C temperature could be reached at that very same end.

Applicant's presently claimed method produces electricity without the production of a significant amount of unwanted greenhouse gas. If one skilled in the art were to substitute the McIntos*h et al.* kiln for the gasification unit disclosed and claimed in Galloway, the result would be the production of a very significant amount of greenhouse gas because of the combustion of char in

the presence of oxygen in the McIntosh *et al.* kiln.

The Applicant's method is designed to produce a quality of synthesis gas that is suitable for the first half-cell of a fuel cell. McIntosh *et al.* is silent on the production of synthesis gas. However, any synthesis gas that is produced in the McIntosh *et al.* catalytic reactor kiln would be of very poor quality for this purpose because of the oxygen that is required for the combustion reaction that occurs in the annulus between the inner and outer cylindrical kilns of McIntosh *et al.* If one skilled in the art were to follow the McIntosh *et al.* teachings, the oxygen would destroy most of any hydrogen produced in the synthesis gas of the Applicant's process. This is the case even though in column 4, line 64 – column 5, line 1 of McIntosh *et al.*, it is stated that the presence of oxygen is eliminated in the inner kiln 15 because pyrolysis gases are exiting through the inlet conduit 50. This simply means that by the time the pyrolysis gases are ready to leave the kiln through pyrolysis outlet vapor line 51 within inlet 50, the oxygen has been flushed from the system at that point. If the McIntosh *et al.* kiln were substituted for the gasification unit disclosed and claimed in Galloway, the resulting synthesis gas would exit the gasification unit at the point where the oxygen concentration would be much higher. This would have a very harmful effect as stated above.

The McIntosh *et al.* method requires steps to avoid the introduction of water with the feed since it adversely affects the combustion of char and results in a poor heat of combustion. Water also causes a very erratic supply of the necessary heat to the inner kiln. In contrast, the Applicant's method can include water in the feed, e.g., see page 8, lines 23-26 of the Applicant's specification. In fact in contrast to the McIntosh *et al.* method that has problems with such variations affecting inlet heating temperatures, the Applicant's method can handle a wide range of waste and a wider range in waste composition.

In summary, it is believed that the Examiner now recognizes that the McIntosh reference does not make up for the deficiencies of Galloway and Webster et al pointed out by the Applicant during the telephone interview of November 14, 2005 with Examiner Lewis and Supervisory Patent Examiner Ryan.

Webster *et al.* teaches a gasifier 16 in which an oxidizing agent such as oxygen is added through line 12 to result in the partial oxidation of a feed of coal and water to form a synthesis gas that is removed through line 40 between the inlet and the outlet line 22 for the solids or slag. This reference makes up for none of the deficiencies of the primary reference of Galloway. The

Examiner admits that this combination of Galloway and Webster *et al.* does not mention a kiln having a solids outlet between the inlet means and the gas outlet means. The Examiner seems to suggest that McIntosh *et al.* does mention such a kiln. However, based on the remarks above, it is clear that McIntosh does not and it would be completely unobvious for one skilled in the art to completely convert the kiln taught by McIntosh *et al.* into anything resembling that of the presently claimed gasification unit.

It is noted in paragraph 4 on page 8 of the February 7, 2006 Office Action that the Examiner refers to the rotary waste feeder of Galloway and refers to this as a rotary waste feeder steam-reforming system. The Examiner then makes the assertion that such a rotary waste feeder steam-reforming system and a rotary kiln are considered functionally equivalent waste feed reforming systems and that it would be obvious to one skilled in the art to substitute a rotary kiln for the rotary waste feeder steam-reforming system of Galloway. A rotary waste feed is shown in FIG. 2 and described in column 6, lines 35-39 of Galloway, where it is stated:

> "Referring now to FIG. 2, the solid carbonaceous waste is passed via line 100 into rotary waste feeder 112 to convert the waste to a gas."

As stated in the above teaching from Galloway, the rotary waste feeder 112 is not a reactor, but simply a means for feeding the waste and for heating the waste to form a gas, which is sent to the reactor or steam reformer 120. There is nothing equivalent in the present method of the Applicant in which the entire carbonaceous feedstock or waste at or near room temperature is introduced into one end of the kiln where the temperature is at about 200°C and it is subjected to increasing temperatures as it moves along the length of the kiln toward the gas exit to achieve a gas exit temperature of from at least about 700°C to about 1600°C and in which the feedstock is converted to synthesis gas as presently claimed. There is nothing in this reference or in any of the other cited references that remotely suggests the presently claimed kiln gasification unit as discussed in detail above.

The Examiner's concluding sentence on page 10 of the February 7, 2006 Office Action appears to be using the hindsight he has gained on reading the Applicant's claimed invention. Such use of hindsight has been prohibited since the U.S. Supreme Court issued its landmark decision in *Graham v. John Deere Co.*, 383 U.S. 1, 36 (1966). The Examiner states that it would have been obvious to one of ordinary skill in the art to use a kiln of McIntosh *et al.* with a solids outlet between the inlet and gas outlet in the gasification unit of Galloway and Webster *et al.* He then

goes on to describe the McIntosh *et al.* system and refers of FIG. 1 of McIntosh *et al.* and states that conduit 36 is between the inlet 5 and gas outlet of the kiln. The only possible way the Examiner could have reached such a conclusion is to use the prohibited hindsight because of all of the reasons set forth above. To summarize, McIntos*h et al.* must have the solids removed at the inlet where the solids are entering through feed conduit 50 because the feed must be immediately subjected to at least about 500°C. If the solids of McIntos*h et al.* were truly removed between the inlet and the outlet there would be no exiting solids to provide the necessary heat for the incoming feed.

Conclusion

In view of the amendment to the claims and the foregoing remarks, Applicant respectfully submits that all pending claims, Claims 1-16 in the present application are allowable. Such allowance is respectfully solicited.

If a telephone conference would expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (415) 984-8200.

Respectfully submitted,

Richard A. Dannells
Registration No: 22,654

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NIXON PEABODY LLP
Suite 900, 401 9th Street, N.W.
Washington, D.C. 20004-2128
(415) 984-8200